

description, which, taken in conjunction with the annexed drawings, discloses preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the drawings which form a part of this original disclosure, in which:

FIG. 1 is a schematic view of the pump apparatus in a preferred embodiment of the invention showing a supply container, a pump assembly, a controller for controlling the pump assembly, and a dispensing head;

FIG. 2 is a partial cross-sectional side view of the pump assembly and supply container;

FIG. 3 is a top view of the supply container;

FIG. 4 is a cross-sectional view of a vacuum generation device;

FIG. 5 is a cross-sectional view of the pump assembly showing an impeller, pressure plates with their corresponding gear, and ring gear;

FIG. 6 is a perspective view of the impeller;

FIG. 7 is a perspective view of a pressure plate in a first embodiment of the invention;

FIG. 8 is a perspective view of the pressure plate in an alternative embodiment of the invention;

FIG. 9 is a top view of a magnetic plate attached to the impeller in a first embodiment;

FIG. 10 is a top view of the magnetic plate in an alternative embodiment of the invention;

FIG. 11 is an end view of the pressure plate of FIG. 7;

FIG. 12 is a partial end view of the pump assembly showing the impeller and the pressure plates in a first position;

FIG. 13 is a partial end view of the pump assembly showing the impeller and the pressure plates in a second position;

FIG. 14 is a partial top view of a lower spur gear on the pressure plate, a ring gear and a tower gear;

FIG. 15 is a cross-sectional view of the dispensing head in one embodiment of the invention showing the flow paths and a pressure switch assembly;

FIG. 16 is a schematic top view of the dispensing head showing the flow paths of the material being pumped;

FIG. 17 is a bottom view of the dispensing head in a first embodiment showing the material outlet, smoothing plate and doctor blade;

FIG. 18 is a top view of the dispensing head of FIG. 17;

FIG. 19 is a side view of the dispensing head in the embodiment of FIG. 17;

FIG. 20 is a side view of the dispensing head in an alternative embodiment having a V-shaped bottom surface for applying material to a corner;

FIG. 21 is a perspective view of the dispensing head of FIG. 20;

FIG. 22 is a schematic block diagram of the controller for the pump apparatus constructed in accordance with a preferred embodiment of the present invention; and

FIGS. 23A, 23B and 23C are a flow chart depicting a sequence of operations for controlling the pumping apparatus in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the present invention is directed to a pulseless pumping apparatus 10 for dispensing a fluid mate-

rial including a supply container 12, pump assembly 14, dispensing head 16 and controller 18 for controlling the output of the pumping assembly. The pumping apparatus 10 of the invention is particularly well suited for pumping viscous materials to a dispensing head 16 for applying the material to a work surface. Controller 18 is connected to dispensing head 16 to sense the flow conditions and pump requirements for the particular dispensing task and control the output flow from the pump assembly 14. A supply tube 20 connects pump assembly 14 to dispensing head 16.

Pumping apparatus 10 in preferred embodiments is mounted on a suitable carriage or provided with shoulder straps and harness (not shown) for carrying on the operator's back. The apparatus can be connected to power outlet or be provided with a self-contained internal power source, such as a battery pack, as discussed hereinafter in greater detail.

Pumping apparatus 10 is able to pump a variety of different viscous materials efficiently and easily. Controller 18 is designed to determine the type of material being pumped and control the operation of pumping assembly 14 according to the type of material by continuously monitoring internal pump pressure and output pressure at dispensing head 16 and adjusting the output flow to meet the requirements of dispensing head 16.

Examples of suitable viscous materials include wallboard joint compound, floor mastics, ceramic tile mastics, wallpaper adhesives and ceiling tile adhesives. Dispensing head 16 is in a form to accommodate the particular material being pumped and includes appropriate tooling to effectively apply the material. For example, a wallboard joint compound uses a tool having a smoothing blade and joint tape dispenser as discussed hereinafter in greater detail. The compositions pumped by pumping apparatus 10 can be standard commercially available materials or can be specially formulated for the particular end use.

FIG. 2 shows a partial cross-sectional view of pump apparatus 10 and supply container 12. Supply container 12 can be a variety of shapes and sizes depending on the material being dispensed and the volume needed. In one preferred embodiment illustrated in FIGS. 2 and 3, supply container 12 includes a hollow plastic jug-like container 30 having an outlet 32 defined by a neck 34. Container 30 preferably has thin flexible walls so that container 30 can collapse as material is withdrawn from within. In this manner, it is not always necessary to vent container 30, although an optional one-way venting valve 36 can be included to allow air to enter container 30.

Neck 34 of container 30 is dimensioned to provide a sufficiently large opening to allow the material to flow easily to pump assembly 14. The outer surface of neck 34 preferably includes external threads 38 for mating with internal threads of a closure cap (not shown). Alternatively, neck 34 can include a lip (not shown) for receiving a suitable closure by an interference fit. Container 30 is preferably housed within a protective housing 44 to prevent crushing or puncturing of container 30. Typically, housing 44 is a crush-resistant cardboard carton enclosing the sides and ends of container 30 and including an opening 46 for neck 34 of container 30.

Supply container 12 in embodiments of the invention includes an identification device for identifying the material in container 30. In the embodiment of FIG. 2, an annular magnet 48 is fixed to container 30 around neck 34. Magnet 48 is characterized by a predetermined gauss assigned to a particular material as a means to identify the material in container 30. Magnet 48 is positioned so that, when supply